Space Weather Technical Forecast

Issued on Wednesday, 16 August 2023 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of G1/Minor Geomagnetic Storm conditions on Day 1 and 2 (16th and 17th). Chance of R1/Minor Radio Blackouts throughout. Chance of Active fluence by Day 4 (19th).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity, as measured at GOES16, has been Low with only low level C-class flaring over the past 24 hours. There are now nine sunspot regions on the visible disc. AR3403 approaching centre disc in the northern hemisphere is the largest group on the disc, with the main spots increasing in size and their umbrae fragmenting into several smaller spots. AR3405 in the far northeast appears to contain a fairly simple magnetic configuration despite its moderate size with no apparent change in appearance since the previous assessment. AR3407 in the southeast has continued to develop, producing some intermediate spots with a beta-gamma magnetic configuration. The other regions appear to be smaller and simpler at present. A filament lifted off from a region around S22E12 at 15/2200 UTC, however, this does not appear to have produced a CME. As a result no Earth-bound CMEs are currently expected.

Solar Wind / Geomagnetic Activity: The solar wind, as recorded by ACE and DSCOVR at L1, was characterized by an ongoing slow solar wind regime. The solar wind speed was at background levels between 270-330 km/s. The density was was average or below. The IMF was weak at 7nT or below. The north-south component varied weakly between +4/-5nT, but was mostly southward directed. The phi angle was variable. The net result of the above solar wind parameters was for Quiet (Kp 0-2) geomagnetic indices throughout.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels.
GOES16 high energy (greater than 2MeV) electron flux varied between background and moderate levels with the diurnal cycle, peaking at 899pfu at 15/1720 UTC. The associated 24-hour integrated fluence remained below Active (1e8 integrated pfu) on a slight decreasing trend reaching 2.23e7 integrated pfu at 16/0001UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is currently Low, however there is a daily Chance of Moderate activity, with the regions most likely to produce significant flares being AR3403, AR3405 and AR3407.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs currently in the forecast. There are up to two coronal hole fast winds due in the period, respectively CH33/+ on Day 1 (16th) which will likely be more geo-effective if it manifests, and then CH35/-, which is perhaps most likely on Day 2 (17th). Initially Quiet geomagnetic conditions should become occasionally Unsettled to Active with a Slight Chance of isolated G1/Minor Storm intervals on Day 1 and 2, but reducing later in the period to likely leave more reliably Quiet conditions.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is

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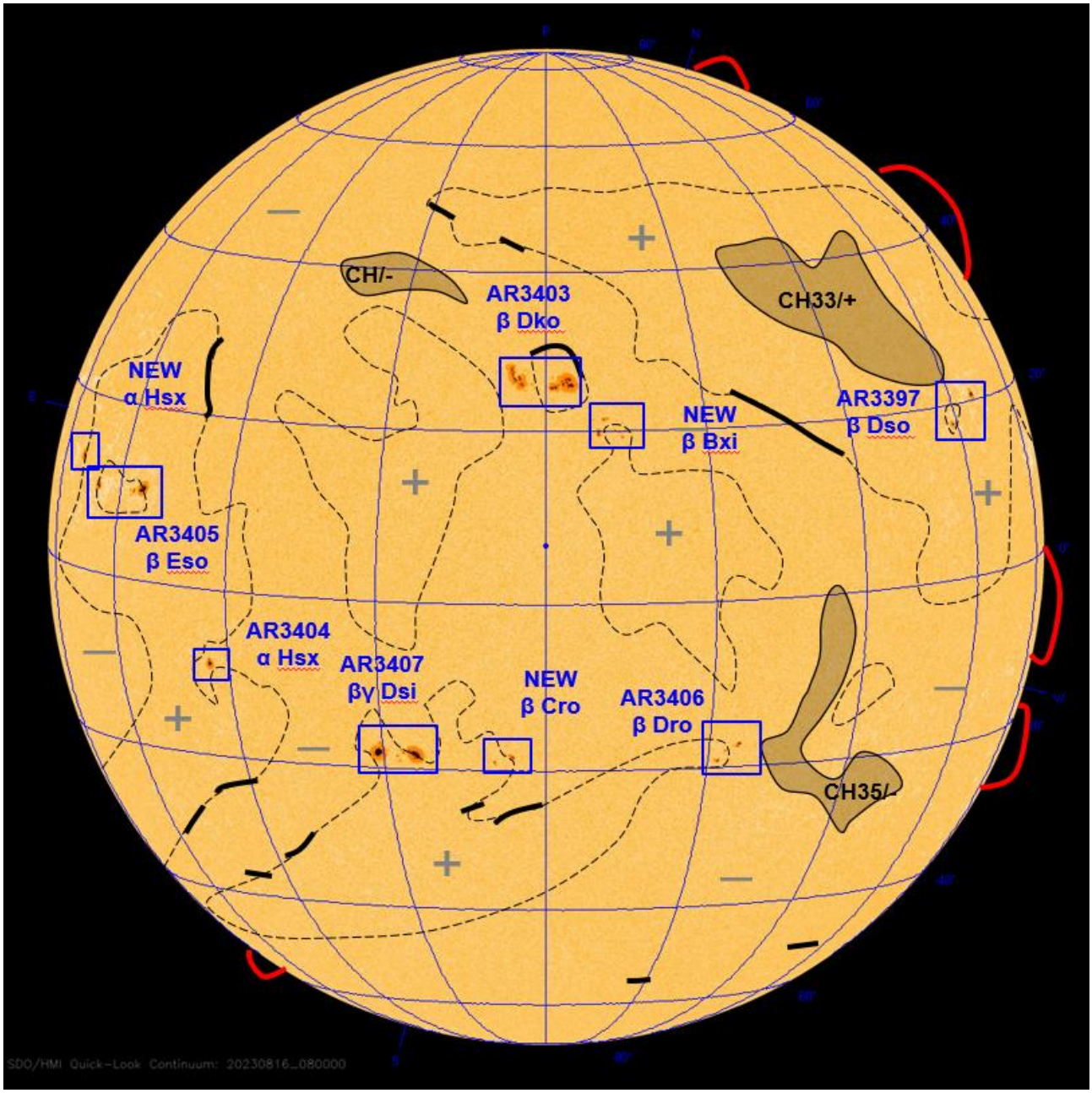
expected to persist at Background.
High energy electron flux (greater than 2MeV) is forecast to continue varying between Background and Moderate levels at first, but with a degree of suppression at GEO expected through midweek in the fast wind regime(s). An overall and increasing Chance of Active electron fluence is indicated for late this UTC week, with an extremely low risk prior to this.

Figure 1. Solar Analysis Valid 16/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs currently in the forecast.

Current slow-ambient solar wind conditions are likely to undergo an increase from CH33/+ during the next 6-12 hours. STEREO A has crossed the Sun-Earth line to again lead Earth in terms of angle, however it has a closer orbital radius of 0.95AU that means that it is estimated to provide around a five-hour or so lead time. Indications at STEREO are that a weak HSS has begun, with a slight increase in magnetic field and wind speeds near 400 km/s.

The duration of any fast wind from CH33/+ at Earth is expected to be relatively short, perhaps only 24 hours, as CH35/- in the southern hemisphere is likely to become dominant. This is of the wrong polarity to generate a significant risk of G1/Minor Storm conditions given the time of year, however it does serve to slightly prolong the small risk from CH33/+ before it. Slightly elevated to elevated wind speeds are expected to ease later in the period.

MOSWOC Enlil has been poor in modelling the current wind speeds, with Enlil suggesting we should have been in a HSS for at least the last 24 hours. As such it is not considered to be giving good guidance at present.

Initially Quiet geomagnetic conditions should become occasionally Unsettled to Active with a Slight Chance of isolated G1/Minor Storm intervals on Day 1 and 2 (16th and 17th), but reducing later in the period to likely leave more reliably Quiet conditions.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs are currently expected.

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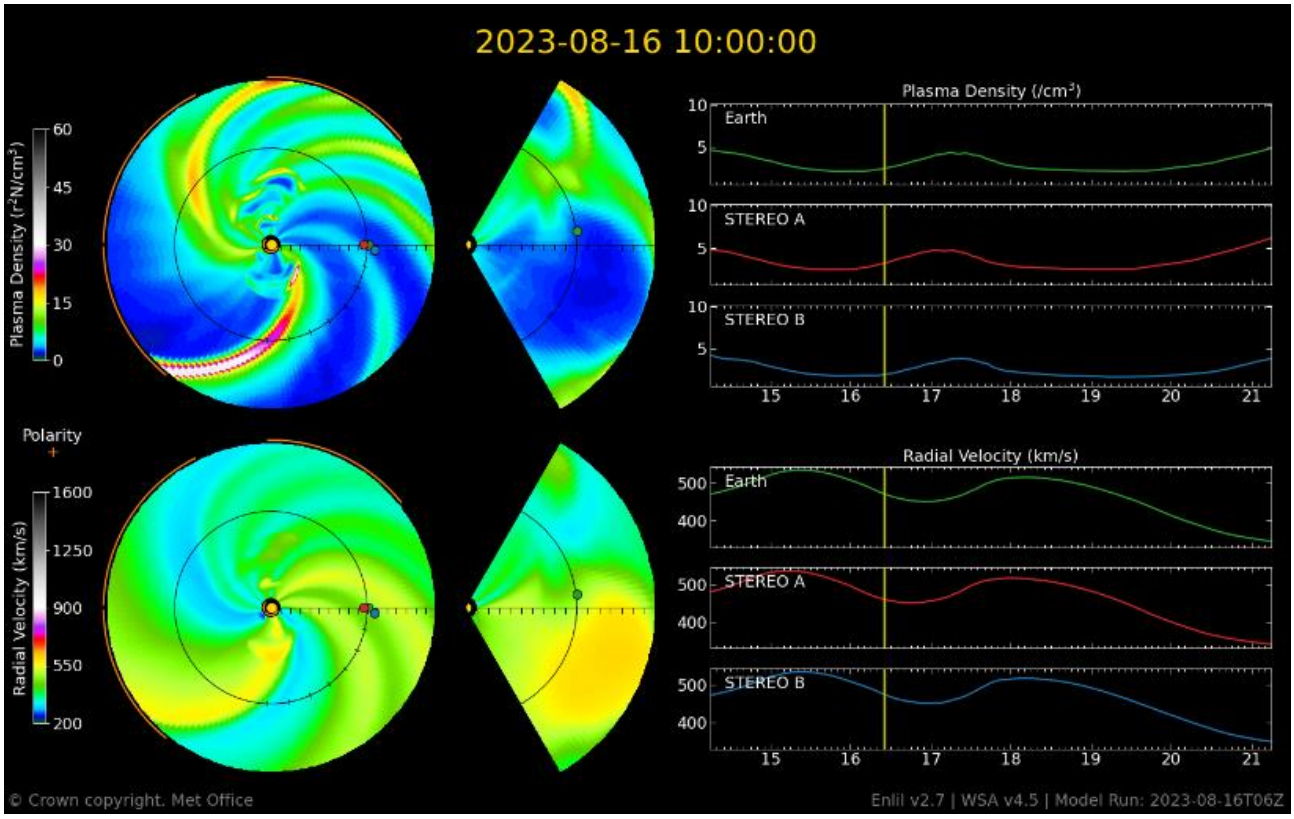
Figure 2: MOSWOC Enlil, which is currently significantly over-estimating the wind speed, likely because it brought in a HSS too early.



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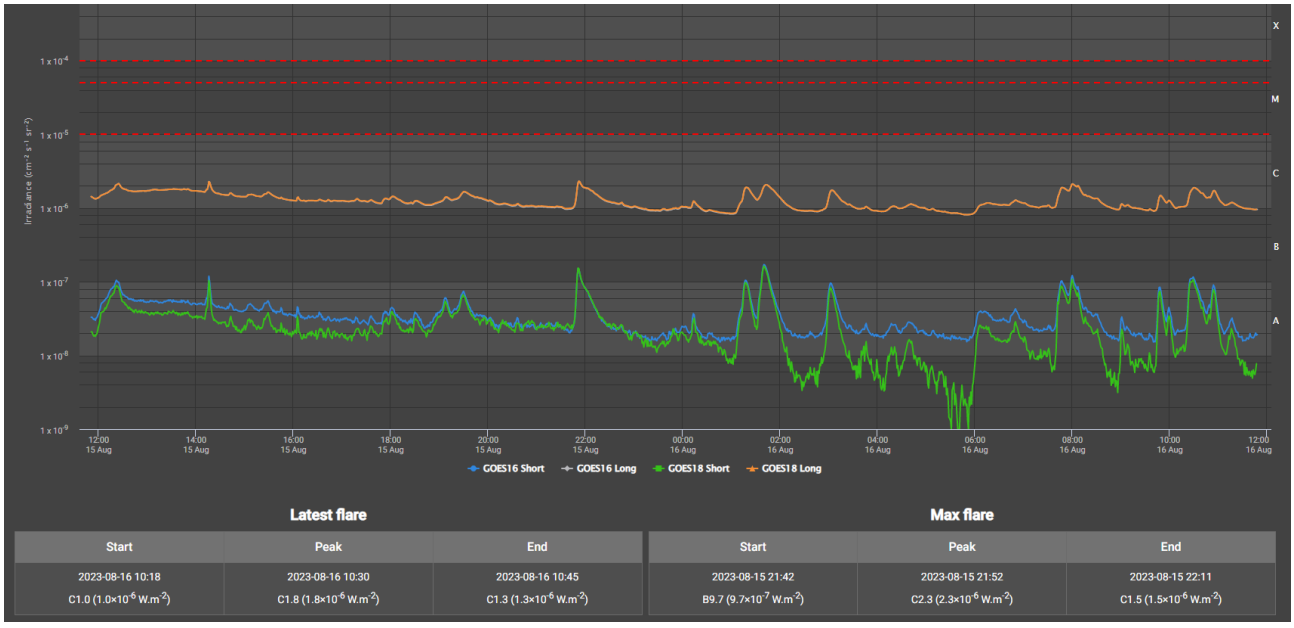
Radio Blackouts - X-Ray Flares:
Solar activity is currently Low, however there is a daily Chance of Moderate activity, with the regions most likely to produce significant flares being AR3403, AR3405 and AR3407.

AR3403 (Dko/Beta) approaching centre disc in the northern hemisphere is the largest group on the disc, with the main spots increasing in size and their umbrae fragmenting into several smaller spots. AR3405 (Eso/Beta) in the far northeast appears to contain a fairly simple magnetic configuration despite its moderate size with no apparent change in appearance since the previous assessment. AR3407 (Dsi/Beta-Gamma) in the southeast has continued to develop, producing some intermediate spots with a beta-gamma magnetic configuration. The other regions appear to be smaller and simpler at present.

Regarding the balance of sunspot group numbers AR3397 leaves the disc in the coming days, meanwhile there are signs that after a hiatus of a couple of days, further regions may arrive over the eastern limb to mitigate. Overall therefore, the flare risk is held constant.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: X-ray flares measured at GOES16 over the last 24 hours. Very little activity.



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Solar Radiation Storms - (High Energy Protons):
The flux of high energy protons (greater than 10 MeV) is at Background. Some of the more complex sunspot regions are still some days away from the better-connecting western horizon, and in any case they have yet to produce significant flare activity. Because of the subdued current disc, barring any further development the proton flux is expected to remain at background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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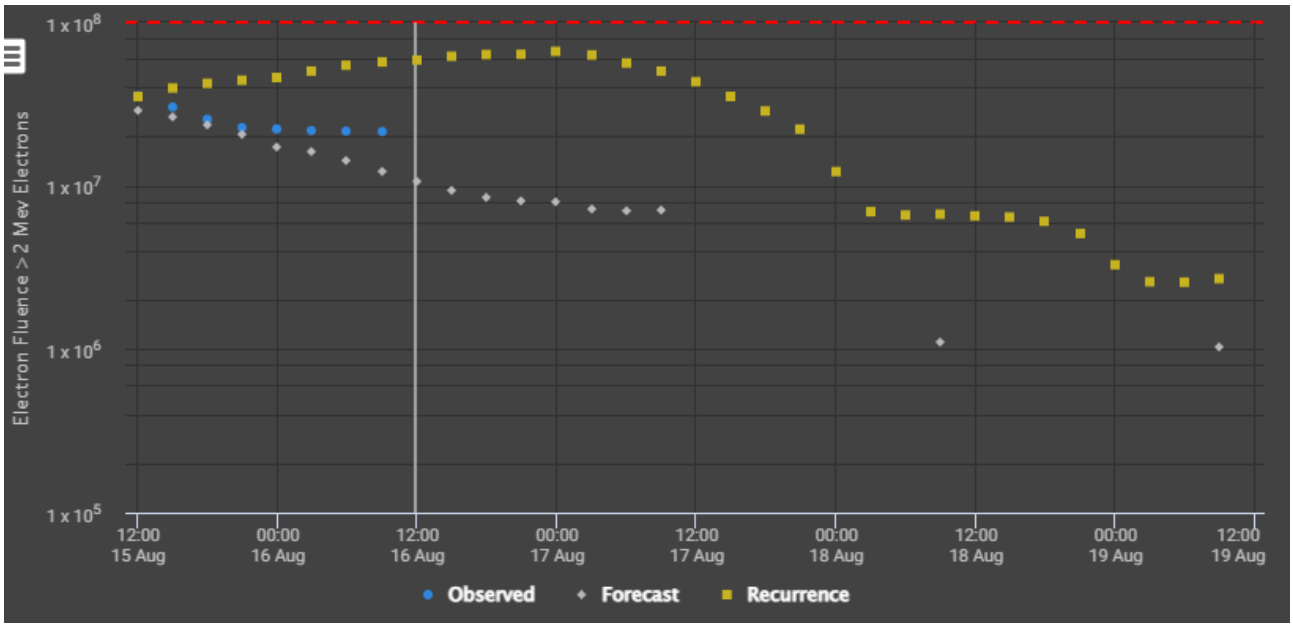
High Energy Electrons Event (≥ 2MeV):
In recent days the high energy (greater than 2 MeV) electron flux at GOES16 has been varying between Normal Background and diurnal peaks of High (above 1000pfu). However, on 16th August a diurnal peak of Moderate was observed and with the onset of two high-speed streams forecast on Day 1 and 2 (16th and 17th) any periods of High flux are considered very unlikely as electron counts at GEO are suppressed for a time.

Confidence in the intervening time period is perhaps a little lower relative to recent issues of this guidance - due to the uncertain timing and duration of the fast winds from CH33/+ and CH35/-. As stated, however, the chances of avoiding any high speed stream from trans-equatorial CH35 are considered very low. The extent of any rebound is therefore the main uncertainty for the forecast overall, rather than the timing, which is reasonably likely to take place later this working week. This should see fluence perhaps responding from late Day 3 (18th) and probably reaching diurnally High values once again. The coronal holes on the disc were present on last pass, but geometry changes serve to lower confidence in persistence, even in the absence of any complicating transient effects.

An overall and increasing Chance of Active electron fluence is indicated for late this UTC week, with an extremely low risk prior to this.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM showing a declining trend. REFM won't be taking account of the expected HSS, so may be underestimating fluence by the end of the period.



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